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AUTHOR	Ingersoll, Richard M.
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ABSTRACT

This paper examines the extent of current or future shortages of qualified U.S. elementary and secondary teachers. Data come from the 1987-1988 and 1990-1991 waves of the Schools and Staffing Survey (SASS), a nationally representative study by the National Center for Education Statistics (NCES). The SASS includes four sets of integrated questionnaires for schools, central districts, principals, and teachers. This analysis includes selected historical and other data from several other large scale surveys; class size data from the National Education Association's Status of the American Public School Teacher Survey; salary and supply data from the NCES' Recent College Graduates Survey; and data on student enrollment, teachers employed, and pupil-teacher ratios from NCES' Common Core of Data Survey. Results indicate that large numbers of principals have trouble finding qualified candidates to fill positions. For both public and private schools, the most common methods of handling difficulties in filling openings are hiring less qualified teachers, assigning teachers trained in another field or grade level, and using substitute teachers. The end result is significant out-of-field teaching. The results suggest that there is not a shortage in the quantity of available teachers, but there are inadequacies in the quality of available teachers. Schools have filled teaching positions, but at the expense of minimal standards of teacher qualification. (Contains 3 tables and 10 references.) (SM)

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TEACHER SUPPLY AND DEMAND IN THE U.S.[1]

By

Richard M. Ingersoll
Department of Sociology
Baldwin Hall
University of Georgia
Athens, GA 30602

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[1] This paper was presented at the 1995 Annual Meeting of the American Statistical Association and appeared in the 1995 *Proceedings of the American Statistical Association.* It draws from a larger research project on the supply, demand and quality of teachers in the U.S., sponsored by the National Center for Education Statistics (contract number RN93140001) of the U.S. Department of Education. This paper does not constitute an official NCES publication; the views expressed are solely those of the author.

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ABSTRACT

Education policy research over the past decade is marked by substantial disagreement over the extent to which there are or will be shortages in the supply of qualified elementary and secondary school teachers in the U.S. This study addresses this debate by examining data from the 1987-88 and 1990-91 waves of the Schools and Staffing Survey - a nationally representative survey conducted by the National Center for Education Statistics of the U.S. Department of Education.

Since the mid 1980s, demand for teachers has, in fact, increased. Both school enrollments and the size of the teaching workforce has increased and an overwhelming majority of schools have had job openings for teachers. Moreover, a number of schools have reported difficulties filling their teaching vacancies with qualified candidates. Despite this, however, there were very few unfilled teaching positions in the 1987-88 or 1990-91 school years. Why?

In reality, schools simply cannot and do not leave teaching positions unfilled, regardless of supply. There are a number of strategies that school administrators can use to reduce shortfalls between the supply of and demand for teachers, including increasing the workloads of existing teaching staff and/or increasing salaries in order to attract more applicants. The data indicate, however, that for both public and private schools, the most common methods of coping with difficulties in filling openings were to hire less qualified teachers, to assign teachers trained in another field or grade level to teach the understaffed courses, and to use substitute teachers. The end result of these coping strategies is substantial levels of out-of-field teaching - teachers teaching in fields for which they did not have adequate training.

This analysis concludes that there has not been shortages in the quantity of available elementary and secondary school teachers in this country. But, our analysis suggests there have been, in fact, distinct inadequacies in the quality of available elementary and secondary school teachers in this country. It appears that schools have filled teaching positions, but only at the expense of minimal standards of teacher qualification. The result: teacher quality has been sacrificed for teacher quantity, rendering the teacher shortage "invisible."

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TEACHER SUPPLY AND DEMAND IN THE U.S.

Richard M. Ingersoll, University of Georgia
Department of Sociology, Baldwin Hall, UGA, Athens, GA 30602

Key Words: teacher supply, teacher shortage, SASS

Introduction

Beginning in the early 1980s, a series of highly publicized reports focused national attention on the imminent possibility of widespread shortages of elementary and secondary school teachers in the U.S. (e.g. Darling-Hammond 1984; National Commission on Excellence in Education 1983). These predictions came as a complete surprise to many. Throughout much of the 1970s, there had appeared to be a surplus of school teachers. Indeed, reductions in the teaching force through layoffs had been common to many schools and districts in the U.S. But, this new research on teacher supply and demand made a compelling case that beginning in the 1980s teacher supply would drastically decrease, while demand for new teachers would steadily increase, resulting in shortages.

Those predicting shortages held that fewer and less qualified college graduates were choosing to teach, while more children of the "baby boom" generation were entering the school system, driving enrollments and, hence, hiring of teachers up. Moreover, a growing imbalance between teacher supply and demand would be exacerbated, according to this view, because of problems of teacher retention. A high level of teacher attrition, in this view, was a large source of demand for new teachers and a key factor behind the predicted shortages (e.g. Haggstrom et al. 1988; Grissmer and Kirby 1987).

These reports arrived in a context of widespread concern and criticism surrounding the adequacy of the elementary and secondary school system as a whole. Critics linked declining U.S. economic performance, especially in the international arena, to declining school performance (e.g. National Commission on Excellence in Education 1983). The apparent inability of schools to attract and retain qualified teachers appeared to be one more in a host of symptoms of the "crisis" besetting schools. As a result, the imminent possibility of teacher shortages gained widespread coverage in the national media.

The education research community was, however, not unanimous in its assessment of the threat of teacher shortages. Some analysts argued that teacher supply was and would continue to be adequate and that attrition was not particularly high (e.g. Feistritzer 1986). A study conducted of Indiana in the late 1980s seemed to provide empirical support for these arguments. It suggested that due to higher salaries and increased re-entry of former teachers, teacher supply had increased, and that due to a stable work force and a decline in turnover among new teachers and women, attrition was actually at its lowest point in years (Grissmer and Kirby 1992).

Currently, research and policy concerning teacher supply and demand seems to be in a state of limbo. Little research has been done to resolve the above contradictory claims. Indeed compared to the 1980s, interest in teacher shortages in the research community, the policy community and in the media seems to have largely disappeared. As a result, it is not at all clear what happened to the teacher shortage.

Almost all involved have agreed that one source of the confusion and irresolution, has been a lack of data, especially at the national level, on the disputed phenomena: the demand for teachers, the supply of teachers and the gap between the two (e.g. Haggstrom et al. 1988). Indeed, it was in order to address these shortcomings, that the National Center for Education Statistics (NCES), the statistical agency of the U.S. Department of Education, fielded a major new survey of schools and teachers in the late 1980s - the Schools and Staffing Survey (SASS).

This paper presents data from SASS that directly address the debate as to whether there are or are not shortages of teachers in elementary and secondary schools in the U.S. in recent years. Our analysis examines what has happened to demand for new teachers, and whether the supply of teachers has been adequate to meet this demand. It examines to what extent schools have difficulty meeting their needs for new teachers, and how they cope with the difficulties they do have. This paper is drawn from a larger ongoing investigation of teacher supply, quality and demand in the U.S. sponsored by NCES. The results presented here build on two previously published documents reporting results from this larger investigation (see Ingersoll 1994 and 1995a).

Data and Methods

The Schools and Staffing Survey is the largest and most comprehensive data source available on the staffing, occupational and organizational aspects of schools in the U.S. It includes a wide range of information on the characteristics, work, and attitudes of school faculty, and on the characteristics and conditions of schools and districts. SASS was designed to be administered triennially; at this point three cycles are publicly available - for the 1987-88, 1990-91 and 1993-94 school years.[1] This analysis used data from the first two cycles.

SASS includes four sets of integrated questionnaires: a school survey; a central district office survey for public schools; a principal survey, and a teacher survey. Response rates have been high, ranging from about

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84 percent for private school teachers to 95 percent for public school administrators. The samples utilized in this analysis contain about 4,800 public school districts, 9,000 public schools, 2,600 private schools, 46,700 public school teachers, and 6,600 private school teachers. All of the data reported here are weighted to be representative of the national populations of teachers, principals and schools in the year of the survey.

Each cycle of SASS obtained a rich array of information on issues at the heart of the shortage debate: the numbers and fields of teaching position vacancies in schools; the degree to which schools experienced difficulties in filling vacancies; the numbers of unfilled positions; the methods that schools used to respond to difficulties in filling vacancies; the sources of new teachers; and the background, characteristics, qualifications and assignments of newly hired and already employed teachers. The literature on teacher supply and demand has held that shortages and staffing problems vary greatly depending upon the type of teacher, school and locality. Typically, analysts have argued that particular fields, such as math, science and special education, and particular kinds of schools, such as those serving poor communities, have borne the brunt of teacher supply and staffing problems in the U.S. (e.g. Darling-Hammond 1984). Following the literature, this analysis will focus on similar comparisons. Our analysis will examine a series of indicators related to teacher supply and demand across different subject fields (math, science, English, social studies, special education, English as a second language, etc.), across school sector (public and private) and, within the public sector, across school poverty level. The poverty level of schools is based on the percentage students enrolled that receive the federal reduced or free lunch program (Low poverty: less than 15%; Medium poverty: 15% to 50%; High poverty: 50% or more).

In order to provide additional context, the analysis also utilizes selected historical and other data from several other large-scale surveys: class size data from the National Education Association's Status of the American Public School Teacher survey; salary and supply data from NCES' Recent College Graduates Survey (RCG); data on student enrollment, teachers employed, and pupil-teacher ratios from NCES' Common Core of Data survey (CCD). These data sources will be noted where discussed in the text.

Results

Shortages of teachers, most simply put, occur where demand, or the number of teaching positions funded, outstrips supply, or the number of teachers available. Analyses of shortages then must begin by assessing demand and supply.

What has happened to the quantity of demand for new teachers?

Demand for teachers appears to be on the rise. Since the mid 1980s, after a decade and a half of decline, school enrollments have steadily increased and are projected to continue to do so (CCD). Total public school enrollment, for example, rose about 5 percent from 1984 to 1990. As a result, schools are hiring teachers. At the beginning of both the 1987-88 and 1990-91 school years, an overwhelming majority of schools had job openings for teachers. Moreover, this hiring was not simply done to replace teachers who moved or retired. The number of employed elementary and secondary teachers has steadily increased since the mid 1980s (CCD). For example, from 1987-88 to 1990-91, the total population of elementary and secondary teachers jumped from 2,630,000 to 2,915,000.

Has the quantity of teacher supply been adequate?

Unlike demand trends, changes in the adequacy of teacher supply are far more difficult to assess. As a result, they have proven to be the focus of the bulk of research on teacher shortages and, hence, will be the focus of this paper.

Much of the research on teacher supply has focused on the teacher reserve pool - the quantity of potential teachers. But, the reserve pool of potential teachers is large, diverse and probably, unknowable. Newly qualified teachers who have recently graduated from state-approved teacher training programs at colleges and universities are perhaps the most obvious and quantifiable source of supply. But, newly qualified teachers comprised only about 20 percent of those hired in 1987-88 and 1990-91.

There are numerous other sources of teachers for teaching jobs. Substantial numbers of newly hired teachers in both 1987-88 and 1990-91 were re-entrants - former teachers who were returning. There were also substantial numbers of delayed entrants - trained teachers who did not seek a position immediately after their schooling. Indeed, as many as 40 percent of newly trained and qualified teachers do not seek teaching positions immediately after their schooling (RCG). Some delay their entrance into teaching and some never teach. All of these newly qualified teachers are potential members of the reserve pool.

The real issue for assessing the adequacy of teacher supply is, however, not the number of potential teachers, but how many trained candidates are available and willing to apply to teaching vacancies. One manner of assessing this "actual" teacher supply is to determine how often schools had hiring problems.

The data suggest that despite the large reserve pool, many schools do, indeed, not find it easy finding qualified candidates to fill openings. For instance, in 1987-88, principals in 40 percent of all public and 47 percent of all private schools reported experiencing some difficulties in finding qualified applicants to fill their teaching vacancies in at least one field. The situation was comparable in 1990-91,

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as illustrated in table 1.

Table 1 —Percentage of secondary schools reporting difficulties filling teaching vacancies with qualified teachers, by field and school characteristics: 1990-91

	English	Math	Life Sciences	Physical Sciences	ESOL or Bilingual	Special Education
Public	11	18	11	15	6	21
Poverty Enrollment						
Low	9	17	10	14	5	19
Med	13	18	11	16	6	22
High	14	21	15	14	7	26
Private	8	21	16	16	4	6

In a number of fields at the secondary level, significant numbers of schools had some trouble filling their teaching vacancies. Even for English positions, often considered a surplus-ridden teaching field, over 10 percent of all schools had some difficulty getting a qualified candidate. This represents about a quarter of all those schools which had vacancies for English teachers. There were also some differences between schools in the likelihood of having hiring difficulties, but not as much as one might expect. In several fields, poor schools, for example, more frequently indicated hiring problems, but often the differences were slight.

Hence, large numbers of school principals had some degree of trouble finding qualified candidates to fill openings in their schools. Moreover, in 1990-91, 11 percent of all principals in the U.S. reported that they had openings that simply "could not be filled with a teacher qualified in the course or grade level to be taught." Despite these widespread difficulties in finding suitable candidates, however, there were very few teaching positions left unfilled in the U.S. In both the 1987-88 or 1990-91 school years, public districts reported, on average, less than 5 percent of their new openings were left vacant or were withdrawn because suitable candidates could not be found. For private schools, the proportion was less than 3 percent. Together these represented far less than 1 percent of all k-12 teachers employed. But, if there were extensive hiring difficulties, suggestive of shortages, why were there so few unfilled teaching positions in the U.S. - perhaps the most concrete indicator of a lack of shortages?

In reality, schools often simply cannot and do not leave teaching positions unfilled, regardless of supply. School staffing is legally mandated - public schools are obligated to provide teaching in subjects required by state law for graduation. Faced with this legal obligation, there are two general strategies by which school officials can reduce shortfalls between the supply of, and demand for, particular kinds of teachers. One involves altering the quantity of teachers demanded and the other involves altering the quantity of teachers supplied.

The first strategy is to decrease the demand for certain kinds of teachers by eliminating positions. This would inevitably result in increases in teachers' course loads, school class sizes, or pupil-teacher ratios. The second strategy is to increase or alter the quantity of teachers supplied. One version of this strategy alters the quantity supplied by filling a position with an underqualified candidate. This could be accomplished by shifting existing staff to areas of greater need; that is, assigning teachers trained in one field to teach in another. For example, social studies teachers could be assigned to teach mathematics courses. Alternatively, school officials could hire the available teacher candidates, regardless of qualifications.

The survey asked principals what means they actually used to cover a vacancy that could not be filled with a qualified teacher. These data for 1990-91 are displayed in table 2.

Table 2 - Percentage of secondary schools that used various methods to compensate for difficulties in filling vacancies, by school characteristics: 1990-91

	Public-Low Pov.	Public-Med. Pov.	Public-High Pov.	Private
Added sections	16	10	12	30
Expanded class size	13	11	9	15
Canceled classes	10	12	5	11
Used PT or itinerant teacher	14	6	12	18
Assigned another teacher	25	22	29	30
Hired less qualified teacher	25	27	21	18
Used substitute teachers	40	51	46	48

Interestingly, principals infrequently turned to the decrease-demand strategy to cope with hiring difficulties. Of public schools that experienced hiring problems, only about 10 percent either expanded class sizes, added additional class sections or canceled classes in order to cover their staffing shortfalls. There were some differences among schools. Poor public schools were slightly less likely to use these three methods, while private schools were slightly more likely to use them, especially the addition of class sections to existing staff.

Data from NCES' Common Core of Data survey corroborate that the decrease-demand strategy has not been used with frequency in recent years. The pupil-teacher ratio

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in both public and private schools actually slightly dropped from 1980 to 1991. For public schools, the ratio decreased from 18.7 to 17.3. For private schools, the ratio decreased from 17.7 to 14.6. Moreover, data from the National Education Association show that the average number of students taught per day by public secondary school teachers, for example, declined from 118 to 93 between 1981 and 1991.

In contrast to the decrease-demand strategy, the data indicate that the increase-supply strategy has been commonly used. For both public and private schools, among the most common methods of coping with difficulties in filling openings in both 1987-88 and 1990-91 were to hire less qualified teachers, to assign teachers trained in another field or grade level to teach the understaffed subjects, and to use substitute teachers. For instance, in 1990-91, 50 percent of public secondary school principals who indicated they had difficulty filling openings, reported using substitute teachers as a remedy. Again, there were not large differences between different types of schools (see bottom half of table 2).

The cumulative effect of these 3 methods is to decrease the numbers of unfilled positions, and to increase the numbers of underqualified staff. Hence, the widespread use of this increase supply strategy necessitates a shift in focus for teacher supply assessments. Rather than focus on whether or not there are, or will be, sufficient numbers of potential or available teachers, these data suggest shortage assessments need to examine the actual fit between the needs of schools and the qualifications of the teachers currently employed. That is, the focus shifts from assessing the adequacy of the quantity of available teachers to assessing the adequacy of the quality of employed teachers.

Has the quality of teacher supply been adequate?

Assessing levels of teacher qualifications and quality, like assessing quantity, is a difficult and ambiguous task. How to define and measure a qualified teacher and quality teaching are subjects of great controversy (Ingersoll 1995b). There is, however, almost universal agreement that one of the most important characteristics of a qualified teacher is training and preparation in the subject or field in which they are teaching. Research has shown moderate but consistent support for the reasonable proposition that subject knowledge (knowing what to teach) and teaching skills (knowing how to teach) are important predictors of both teaching quality and student learning (for a review of this research, see Darling-Hammond and Hudson 1990). Knowledge of subject matter and of pedagogical methods do not, of course, guarantee qualified teachers nor quality teaching, but they are necessary prerequisites.

Hence, one method of assessing the adequacy of teacher supply is to focus on levels of basic teacher qualifications and training. But, it must be noted that the issue for assessing the adequacy of teacher supply is not a lack of basic training and qualifications on the part of teachers. The data indicate that most teachers in the U.S. have basic training. For example, 98 percent of all teachers newly hired in the 1990-91 school year held a bachelor's degree and over a third had obtained a graduate degree. Moreover, 88 percent of these newly hired held teaching certificates. The issue in question is the phenomenon of out-of-field teaching - teachers assigned to teach subjects that do not fit their fields of training. The last portion of this analysis will focus on out-of-field teaching as an indicator of inadequacies in the available supply of teachers.

Of course, it must be noted that some degree of out-of-field teaching may be unavoidable and may not always be an indicator of a shortage of qualified and available teaching candidates. School administrators charged with the task of offering programs in a range of required and elective subjects may often be forced to make spot decisions concerning the assignment of available faculty to an array of changing course offerings. But even low levels of out-of-field teaching are meaningful to teacher supply assessments. This is especially true for the case of high schools and for the core academic fields. In high schools, teachers are divided by fields into departments; faculties are thus more specialized than in elementary schools, and therefore the differences between fields are more distinct and, perhaps, greater. Moreover, the level of mastery in different subjects is higher in high schools, and hence a clear case can be made that teachers ought to have adequate background in the subjects they teach. Hence, the remaining portion of this section focuses on the levels of and variations in out-of-field teaching in high schools.[2]

Table 3 — Percentage of high school teachers who taught one or more classes in a field without at least a minor in that field, by field and school characteristics: 1990-91

	Math	Science	Social Studies	English
Total Overall	32.1	18.7	18.9	23.2
Public	30.5	16.9	16.9	21.9
Poverty Enrollment				
Low	27.7	14.0	15.7	19.2
Medium	31.8	20.3	19.2	24.5
High	40.0	20.2	18.0	30.7
Private	41.0	28.6	30.3	32.0

In fact, substantial numbers of high school teachers were assigned to teach out of field or out of department in both 1987-88 and 1990-91. While most high school teachers had a undergraduate or graduate major in their main teaching assignment field, large numbers of teachers

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were assigned to teach courses in additional fields for which they did not have a major or even a minor. In 1990-91, public high school teachers taught, on average, about 15 percent of their class schedules in fields for which they did not have even a minor. This amounted to about one course in six. Private high school teachers taught far more of their classes without minimal qualifications. On average, for about one-quarter of their scheduled classes, teachers did not have at least a minor in the field. These percentages all substantially increase (sometimes double) if the standard is raised from a minor to a major in the field taught. As a result, substantial numbers of high school students were taught core academic classes by teachers without even minimal training in the field. These levels of out-of-field teaching, however, varied substantially by field, as shown in table 3.

In 1990-91, 23 percent of all high school English teachers did not have at least a college minor in English, language arts, journalism or communication. Thirty two percent of all high school mathematics teachers did not have at least a minor in mathematics or mathematics education. Nineteen percent of high school science teachers did not have at least a minor in any of the biological, physical or natural sciences or science education. Nineteen percent of high school social studies by teachers did not have at least a minor in history, any of the social sciences or social studies education.

Out-of-field levels also varied considerably across different types of schools. Notably, public schools with a high proportion of poverty-level students had a higher proportion of out-of-field faculty in mathematics, science, and English than schools with less than 20 percent poverty-level students. In several fields, these high levels were overshadowed by those in private schools, in which, for example, 59 percent of mathematics teachers and 47 percent of English teachers out of field.

Conclusion

This paper addresses the ongoing debate as to whether there are shortages of teachers in the U.S. If one accepts the premise that adequate staffing requires high school teachers to hold at least a college minor in the fields which they teach, then this analysis suggests that many of the nation's schools have not been adequately staffed.

Analysts have offered three possible explanations for inadequacies in the supply of teachers. Some have suggested that inadequacies are due to insufficient training of teacher candidates. Some have suggested that shortages are due to insufficient numbers of trained teachers. Finally, others have suggested that staffing inadequacies are due to an inability of many schools to attract adequate numbers from the pool of existing trained teacher candidates to seek positions.

First, are staffing inadequacies, such as out-of-field assignments, due to inadequacies in the qualifications of the supply of teachers? That is, is out-of-field teaching a problem of poorly trained teachers? In fact, the data suggest that the prevalence of out-of-field teaching is not due to a lack of basic teacher training. Most high school teachers in the United States had completed a college education and, indeed, over half had acquired graduate degrees. The inadequacies lay in the fit between teachers' fields of training and their teaching assignments. Many teachers were assigned to teach classes which did not match their education or training. Hence, increased and improved teacher training, while a worthwhile goal and the object of much current research and reform, may not reduce levels of out-of-field teaching.

Second, are staffing inadequacies, such as out-of-field assignments, due to inadequacies in the quantity of the supply of teachers? That is, is out-of-field teaching a problem of too few teachers? In fact, the data suggest that the supply of potential teachers in the larger population is both large and diverse. Only a small proportion of the newly hired come directly from training institutions; a large proportion are either re-entrants or delayed entrants. This suggests that out-of-field teaching assignments are not due to insufficient numbers of trained teachers and, thus, for example, increasing enrollments in teacher training programs, the goal of some current education reforms, may not be an effective method of reducing levels of out-of-field teaching.

But, despite the large and diverse reserve pool and the widespread extent of basic training held by teachers, many school principals report experiencing difficulties in hiring qualified candidates. As a result, they turn to the use of substitute teachers, in-school reassignments and hiring of the underqualified as strategies for coping with these difficulties. Hence, although there may be many reasons for out-of-field assignments, a leading factor appears to be the inability of schools to obtain or retain sufficient numbers of candidates from the existing pool of trained teachers.

The data, however, do not establish the sources of this inability. For example, it is unclear if out-of-field assignments are an emergency condition resulting from spot shortages of particular types of teachers at particular times in particular places, whether they are a short-term condition due to fiscal constraints in particular settings, or to what extent they are a chronic condition because this is a normal and ongoing practice in particular schools. Moreover, if most out-of-field teaching is a remedy for difficulties in hiring, it is not at all clear whether the root of the problem is the unwillingness of existing trained teacher candidates to seek positions, or whether the root of the problem is the unwillingness of schools to attract, effectively utilize and retain existing trained teacher candidates, or both.

Whatever the reasons, the data suggest a story that is both provocative and unsettling: There has not been shortages in the quantity of available elementary and

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secondary school teachers in this country. But, our analysis suggests there have been, in fact, distinct inadequacies in the quality of available elementary and secondary school teachers in this country. Schools have filled teaching positions, but only at the expense of minimal standards of teacher qualification. The result: teacher quality has been sacrificed for teacher quantity, rendering the teacher shortage "invisible."

Endnotes

1. SASS data tapes, survey questionnaires and user's manuals are available from NCES, U.S. Department of Education, 555 New Jersey Ave., Washington, D.C. 20208-5641. For an extensive report summarizing the items used in this investigation and providing an overview of the entire survey see Choy et al. (1993).

2. This analysis of out-of-field teaching borrows heavily from the larger study on teacher supply, qualifications and turnover mentioned earlier (see Ingersoll 1995a). As the report shows, out-of-field teaching can be empirically measured in a number of ways. The measure of out-of-field teaching used here focuses on whether each of those, who taught one or more classes, in each of 4 broadly defined fields, had a minimum of substantive training in that field. More specifically:

(A.) substantive training - I focus whether teachers had formal training in a discipline, rather than formal training in teaching methods and pedagogy i.e. certification.

(B.) minimal levels - I focus on whether teachers had at least a college minor in the field.

(C.) broadly defined fields - Fields are defined parallel to conventional departmental divisions in high schools. That is, fields include all within-department disciplines. Hence, for example, a minor in any of the natural, physical or biological sciences is considered adequate training to teach any science course.

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